

# Influence of Temperature and Solid Concentration on the Physical Properties of Noni (*Morinda citrifolia* L.) Juice

Andri Cahyo Kumoro · Diah S. Retnowati ·  
Catarina S. Budiati

Received: 12 April 2009 / Accepted: 28 August 2009  
© Springer Science + Business Media, LLC 2009

**Abstract** The effect of temperature on the physical properties of fresh noni (*Morinda citrifolia* L.) juice with three different solid concentrations (5, 10, and 15°Brix) was investigated. The flow behaviour index ( $n$ ) and thermal conductivity ( $k$ ) were found to increase with the increase in temperature. On the other hand, the juice density ( $\rho$ ) and consistency coefficient ( $K$ ) were found to decrease with increasing temperature. The increase in solid concentration leads to increase juice density and consistency coefficient, but reduce flow behaviour index and thermal conductivity. The experimental data were then correlated with temperature and solid concentration using nonlinear regression equations or empirical models. It was found that the physical properties calculated using proposed equations agree well with the experimental data with coefficient of determinations ( $R^2$ ) ranged from 0.9897 to 0.9998.

**Keywords** Noni · Consistency coefficients · Flow behaviour index · Density · Thermal conductivity

## Nomenclatures

$a_1, a_2, a_3$	Constants in Eq. 7
$b_1, b_2, b_3$	Constants in Eq. 8
$C$	Solid concentration °Brix
$c_1, c_2, c_3$	Constants in Eq. 9
$d_1, d_2, d_3$	Constants in Eq. 10
$k$	Thermal conductivity of the sample, ( $W \cdot m^{-1} \cdot ^\circ C^{-1}$ )
$K$	Consistency coefficient, ( $Pa \cdot s^n$ )

$L$	Length of the copper cylinder used in Eq. 6, ( $m$ )
$n$	Flow behaviour index, (-)
$q$	Heat flux in the thermal resistance, ( $W$ )
$r$	Radius, ( $m$ )
$R_1, R_2$	External and internal radius of the internal and external cylinder, ( $m$ )
$S$	Surface area of a cylinder of radius $r$ , ( $m^2$ )
$T$	Temperature, ( $^\circ C$ )
$T_1$	Steady state temperature in the internal cylinder, ( $^\circ C$ )
$T_2$	Steady state temperature in the immersing cell thermostatic bath, ( $^\circ C$ )

## Greek

$\gamma$	Shear rate, ( $s^{-1}$ )
$\eta$	Viscosity, ( $Pa \cdot s$ )
$\rho$	Density, ( $kg \cdot m^{-3}$ )

## Introduction

Noni is the Hawaiian name for the fruit of *Morinda citrifolia* L. (Rubiaceae). It is well known as “mengkudu” in Indonesia, Malaysia, and Singapore (Wang et al. 2002). Noni is native from Southeast Asia to Australia and is cultivated in Polynesia, India, the Caribbean, and Central and northern South America (Dixon et al. 1999; Ross 2001). In traditional pharmacopoeia, the fruit is claimed to prevent and cures several diseases. It is primarily used to stimulate the immune system and thus, to fight bacterial, viral, parasitic, and fungal infections; it is also used to prevent the formation and proliferation of tumours, including malignant ones (Dixon et al. 1999; Earle 2001). Noni juice is also claimed to relieve inflammation. Most noni is consumed as juice, although leaves, flowers, bark, and roots

A. C. Kumoro (✉) · D. S. Retnowati · C. S. Budiati  
Department of Chemical Engineering, Faculty of Engineering,  
Diponegoro University,  
Prof. H. Sudharto, SH Road, Tembalang Campus,  
Semarang, Indonesia  
e-mail: c.k.andrew@undip.ac.id